West Lake Landfill Fate & Transport Draft Scope of Work

INTRODUCTION

The West Lake landfill represents a complex site that is influenced by its setting at the edge of the Missouri River alluvium (a regional groundwater discharge area), historical disposal activities, suite of radioactive contaminants, and proximity to dewatering at an adjacent sanitary landfill located within a former bedrock quarry. The purpose of this fate and transport (FT) work plan is to develop a better understanding of the site conditions and how they influence the physical and geochemical behavior and contaminant transport, particularly radionuclide constituents. An iterative adaptive management approach is utilized to take advantage of the historical data already available from the site to develop a comprehensive conceptual site model and, as needed, improve the existing groundwater monitoring network. Recent (2011-2013) ground water sampling activities at the site have yielded new information on groundwater levels and geochemistry. Building on this new groundwater information, and the better understanding of physical and chemical form of the radioactive-impacted material (RIM) and its weathering behavior, will manifest in an improved understanding of contaminant transport at the site.

The scope of work laid out will concentrate on three areas: RIM form and leachability, physical flow regime, and groundwater geochemical attributes.

In response to comments on the Focused Supplemental Feasibility Study (SFSS), a significant quantity of additional water-quality and ground-water level data has been collected within the past 20 months at the site. In addition, background groundwater quality data has been or is being collected from location offsite, in particular for radionuclides. The additional groundwater data collected represents a unique opportunity to verify, and revise the existing Site Conceptual Model (SCM) and provide additional confidence in understanding the FT of contaminants of concern (COCs), particularly radionuclides at/from the site. The additional effort is being undertaken because of the longevity and in-growth of some of the radionuclides and to reduce to the extent possible the uncertainty in the current SCM and the FT of COCs.

In response to discussion on the draft Scope of Work for additional FT modeling, the EPA puts forth the following suggested guidelines for revision of the draft FT scope of work. These comments lay out a strategy that, while incorporating FT modeling, stresses greater use of the general comprehension of the site by ensuring a comprehensive SCM that is consistent with all available data. Modeling is still supported, but it is to be used in a supporting role that is to lay out boundary conditions for assessing FT of COCs. Essential to success of the FT effort is a comprehensive SCM that captures the hydrology and geochemistry at the site and is consistent with current GW data and that should reconcile any disparity in water quality in wells southeast of the north quarry (such as PZ-101-SS and others) and the presumed groundwater divide that has been hypothesized to exist between Area 1 and those wells. At key stages in the process, the parties should convene to adaptively manage the investigation and modeling activities in order to efficiently incur costs and maximize time.

The SCM and FT effort should also be forward looking to enable better visualize how the vadose and groundwater systems might operate in the projected future time period (i.e., 1,000 and 9,000 years). The FT effort should be coordinated with other respondent activities at the site and flexibility in site activities should allow the opportunity for RIM to be characterized (chemical, physical, mineralogic, and radiochemical).if any invasive activities at the site occur that encounter such material. To meet the proposed goals, the EPA puts forth the following work elements:

1- The respondent should provide a revised site conceptual model that incorporates and is consistent with the additional data collected during 2012-2013. Care should be taken to incorporate complexities in groundwater flow and additional evaluation of groundwater level and water-quality data in the vadose and saturated zones. Part of this effort includes additional evaluation of groundwater levels beyond what has been presented previously.
   a. This should include revised cross sections that incorporate the extent of the 2012-2013 site GW data. Cross sections should show accurate relations of OU1 and OU2 disposed fill and known RIM, thickness of alluvium, and bedrock units (St. Louis Limestone, Salem Limestone, Warsaw Formation, Burlington-Keokuk formation, in relation to the nearby Bridgeton landfill (its sump etc.), dewatering well sumps, and monitoring wells. Care should be taken to accurately reflect the relation between the former quarry floor elevations, leachate risers, and nearby monitoring well open intervals.
   b. Incorporation of vertical groundwater gradient. At issue is that there are vertical gradients that have been identified in both the alluvial and bedrock aquifers. Particularly with the bedrock aquifer, the relationship of well screen elevations to each other and to the bedrock/alluvium surface will influence the measured head in the well. The respondent needs to make additional effort to examine groundwater levels in 3-D rather than the simple 2-D framework. A review of well construction diagrams indicates that elevation differences in well screens may be several tens of feet or more and combing this with strong vertical gradients in the bedrock, can lead to additional uncertainty in potentiometric maps. Potentiometric data and maps should be re-examined after considering “normalized” head elevations in wells (especially bedrock wells) with known vertical gradients perhaps using software such as Oasis montaj ™ or one of many other suitable packages to work with these normalized heads.
   c. Evaluation of nearby dewater pumping on selected “key” monitoring wells (i.e. continuous WL recording for a selected period to see if switching on of pumping wells can explain complexities in interpreted flow that the respondent has attributed to such pumping). The revised SCM should take into account that water levels in pumping wells may not be an accurate reflection of groundwater levels within the fill in adjacent former quarry areas.
   d. The revised SCM model should be consistent with the current available GW data. The SCM should be able to explain differences in major ion and radionuclides in the alluvium and bedrock aquifer without reliance on generalized literature references that are not

applicable to the site. The SCM also should be consistent with major ion data and anomalous radionuclide levels in wells such as PZ-101-SS.

e. The conceptual site model should also include a discussion of background groundwater quality in the alluvium and bedrock including common landfill indicator parameters (such as Ca, Na, Cl, B, Cr, Sr, I, or others) as well as radionuclides. Data from previous monitoring wells no longer in existence should be incorporated.

f. Evaluation of precipitation on the moisture regime within the disposed fill and its infiltration into the alluvium and its impact on the potentiometric surface.

2- As part of providing additional understanding of FT of radionuclides in particular, additional evaluation of respondents FT work plan is needed. As part of this additional evaluation, EPA agrees that including some of the elements in the draft FT scope of work such as application of geochemical models will greatly aide in understanding FT of long-lived radionuclide COCs. However, the graded approach as presented in the draft FT SOW was misapplied and not appropriate. Also, the FT modeling effort may benefit from avoiding complexities such as kinetics that require additional assumptions. The suggested approach might be the following with allowance for interaction with EPA as necessary between each step :

a. Initial equilibrium geochemical modeling of interaction between RIM (physical and chemical composition estimated from exiting data) and landfill leachate end members to set boundary conditions. Simulation under both oxic and anoxic conditions should be considered. Modeling should include current and maximum predicated future RIM activity (i.e. 9,000 years) to establish if a worst-case scenario even exists before pursuing additional modeling exercises.

b. Include several leachate signatures (from site leachate wells, seeps, relevant literature generic leachate etc.) and perhaps a rainwater/DI scenario to capture the range from "strong" leachate to minimal leachate impact (e.g. infiltration signature out 100s years). The proposed source terms for radionuclide phases as provided in the draft FT SOW seem reasonable but radionuclide contents in solid phases considered should cover the range of activity in RIM known to exist today (e.g. 5%, 50%, and 95 percentile radionuclide activity values) and also what radium (Ra) and mobile radioactive constituent contents in RIM would be at 1,000 yr and 9,000 yr (maximum Ra from Th decay). Characterization of actual RIM is desirable as described in (d) below. Also, the stability/maximum solubility (assume equilibrium) of radionuclides COCs in existing site groundwater (alluvium and bedrock) can readily be estimated with existing data through solubility calculations.

c. Data from any RIM characterized during other activities at the site should be incorporated and samples of RIM encountered through those other activities should be archived for potential future geochemical analyses and modeling. Undertake analyses of RIM to identify key solids phases in the RIM and its chemical, radiological and mineralogic composition for simulations. Specific grain analyses (such as SEM with EDS/WDS and fission-track screening) can be useful for identifying phase associations of radionuclides. Consideration should be given to activities scheduled for other purposes that would minimize collection costs.

d. Batch leaching studies of collected/archived RIM material can be used in combination with theoretical molding results and would enhance confidence in modeling results.
e. Use the range of end member results from (a) above to perform additional forward geochemical calculations considering mixing and interaction with selected solutions representing background alluvial and bedrock groundwater and selected solid phases that may affect FT of radionuclide COCs described in the draft SOW submitted such as Fe oxyhydroxides, calcite, sulfate/sulfides and other phases and species discerned from the initial geochemical screens. Simple two component (step a result plus shallow alluvial a = result) models as well as multi-step mode runs (step a output + shallow alluvial + shallow bedrock = result) may be desirable. Respondent may choose to incorporate 1-D transport.
f. Compare results from step (d) to existing GW QW data, such as wells that have Ra above MCL and those that do not. Consideration should be given to comparing forward simulations with reverse simulation where data from "key" monitoring wells with elevated radionuclides and perhaps several without is used.

3. A -3D model of groundwater flow is needed to aid in the design of a long-term groundwater monitoring network for the site. The model may be focused on the alluvial aquifer, or a combination of alluvium and bedrock. This step is a longer-term effort and results from previous steps are needed before scoping.